APPENDIX A
DRY WEATHER MONITORING

Section 3.2.3 of this permit requires ADOT to develop and implement a program that will detect and eliminate illicit connections and discharges to and from the MS4.

An illicit discharge, as defined in this permit, is any discharge to a MS4 that is not composed entirely of stormwater except discharges pursuant to an AZPDES permit. ADOT shall use dry weather field and analytical monitoring to identify outfalls/conveyances that are discharging non-stormwater and conduct follow up studies as necessary to detect and eliminate illicit discharges.

A. Program Requirements

ADOT shall conduct dry weather field screening and analytical monitoring, including the following tasks:

- Develop and complete an MS4 map;
- Select dry weather field screening and analytical monitoring sites (see Part B below);
- Provide training for field staff (see Part D below);
- Establish a record keeping system (see Part E below);
- Develop dry weather field screening and analytical monitoring procedures;
- Conduct dry weather field screening and analytical monitoring;
- Conduct follow-up source identification investigation and elimination activities;
- Submit an outfall map and field screening procedures as part of the SWMP; and
- Summarize and report the results of dry weather field screening and analytical monitoring, including the identification and elimination of illicit connections and illegal discharges (see Annual Report Form - Appendix B).

B. Field Screening Location Selection

Field screening points shall be either major outfalls or other outfall points (or any other point of access such as manholes) randomly located throughout the storm sewer system by placing a grid over a drainage system map and identifying those cells of the grid which contain a segment of the storm sewer system or major outfall. The field screening points shall be established using the following guidelines and criteria or other alternative methods that have been approved by EPA:

(1) A grid system consisting of perpendicular north-south and east-west lines spaced 1/4 mile apart shall be overlaid on a map of the municipal storm sewer system, creating a series of cells;

(2) All cells that contain a segment of the storm sewer system shall be identified; one field screening point shall be selected in each cell; major outfalls may be used as field screening points;

(3) Field screening points should be located downstream of any sources of suspected illegal or illicit activity;

(4) Field screening points shall be located to the degree practicable at the farthest manhole or other accessible location downstream in the system, within each cell; however, safety of personnel and accessibility of the location should be considered in making this determination;

(5) The assessment and selection of cells shall use the following criteria: hydrological conditions; total drainage area of the site; population density of the site; traffic density; age of the structures or buildings in the area; history of the area; and land use types;

(6) For medium municipal separate storm sewer systems, no more than 250 cells need to have identified field screening points; in large municipal separate storm sewer systems, no more than 500 cells need to have identified field screening points; cells established by the grid that contain no storm sewer segments will be eliminated from consideration; if fewer than 250 cells in medium municipal storm sewers are created, and fewer than 500 in large storm sewer

systems are created by the overlay on the municipal sewer map, then all those cells which contain a segment of the storm sewer system shall be subject to field screening (unless access to the separate storm sewer system is impossible); and

(7) Large or medium municipal separate storm sewer systems which are unable to utilize the procedures described in Paragraphs (1) through (6) of this section, because a sufficiently detailed map of the separate storm sewer systems is unavailable, shall field screen no more than 500 or 250 major outfalls respectively (or all major outfalls in the system, if less); in such circumstances, ADOT shall establish a grid system consisting of north-south and east-west lines spaced 1/4 mile apart as an overlay to the boundaries of the municipal storm sewer system, thereby creating a series of cells; ADOT will then select major outfalls in as many cells as possible until at least 500 major outfalls (large municipalities) or 250 major outfalls (medium municipalities) are selected; a field screening analysis shall be undertaken at these major outfalls.

C. Monitoring Frequency

The permit requires ADOT to continue to inspect outfalls to detect illicit discharges. In the first year of the permit term, ADOT is required to inspect half of the 71 major outfalls identified in the September 2005 Phase I and Phase II Storm Water System Maps. In the second year of the permit term, ADOT is to inspect the remainder of these 71 major outfalls. This is a phase-in provision as the permit requires annual inspection of all 71 each year thereafter in the remainder of the permit term. Outfalls where non-stormwater flows are detected should continue to be monitored at a higher frequency as required to identify and/or eliminate the discharge source. Monitoring of priority outfalls, as described in this permit, is required at least once each year. Dry weather monitoring should not be conducted within 72 hours of the end of any rain event to minimize the likelihood that the discharge contains stormwater runoff.

D. Training

Field personnel should be properly trained to gather consistent and accurate results from field observations and sample analysis. In addition, field personnel shall be trained to follow strict sampling and chain-of-custody protocols when conducting dry weather analytical monitoring.

E. Recordkeeping

This permit requires ADOT to establish a record keeping system to track and record the findings of outfall monitoring, such as the condition of outfalls, outfall maintenance needs, presence of dry weather flows, sampling conducted, and investigations initiated. Field data sheets, laboratory reports, and any other monitoring documents must be retained according to the record retention requirements in this permit.

1. Field Data Sheet

ADOT shall describe visual observations made during dry weather periods for each field screening site. The field screening observations and results of the field water quality analyses shall be recorded on a standard field data sheet. The field data sheet will also serve as a record of the field visit and must be completed for every site visit regardless of whether samples are collected.

An example of a field data sheet that may be used to record dry weather monitoring information is provided in Appendix G of the Illicit Discharge Detection and Elimination (IDDE) guidance manual (see Section I, References).

2. Laboratory Reports

Laboratory results are needed to aid in the identification of potential pollutant sources and illicit discharges. A copy of the laboratory reports should be attached to the appropriate field data sheet for reference.

F. Field Screening and Analytical Sampling

1. Field Screening Observations

Field screening observations include a series of qualitative (mainly visual) observations of physical and biological conditions at the site, such as the location, type, and condition of the outfall. These observations are intended to provide a general assessment of the site and should include parameters like the presence of floatables, visible deposits/ stains, and vegetation. Information relating to weather conditions, such as the amount of time since last rainfall/ stormwater discharge, should also be documented. This information should be recorded on a field data sheet. Each field screening location should be photographed during each visit to provide additional information and documentation of site conditions.

Qualitative field observations must be made and documented on the field data sheet during each site visit whether or not flowing water or other evidence of a non-stormwater discharge is observed. Observations of each site can be categorized as (a) Non-flowing, (b) Evidence of Past Discharge, or (c) Flowing Discharge, or (d) Flowing Discharge from Obvious Source.

(a) For those sites at which no flow or ponded water is observed, ADOT shall document field screening observations, including photographs.

(b) For those sites at which no flow or ponded water is observed, but evidence of a non-stormwater discharge is present, such as staining, ADOT shall document field screening observations and continue to monitor the location as necessary to identify and/or eliminate the source. Evidence of present or past illicit connections and illegal discharges to the MS4 can often be ascertained by careful field observations.

(c) For those sites at which a dry weather discharge is occurring at the time of inspection, ADOT shall document field screening observations followed by source investigation within 15 days including field screening analytical monitoring or laboratory analytical monitoring if the source cannot be readily identified.

(d) For those sites at which a dry weather discharge from an obvious source is occurring at the time of inspection (e.g. substantial petroleum sheen, extremely high ammonia concentration, evidence of a sewage release), ADOT shall document field screening observations and immediately begin efforts to eliminate the discharge.

2. Flow Measurement

A flow measurement should be made during each site visit at sites with flowing discharges. Flow measurements can be used to estimate pollutant mass loading, prioritize storm drains for future investigation, or to identify significant changes in discharge that may be indicative of an illegal release upstream. In the absence of a permanent flow measurement installation, field methods should be employed to measure discharge rate.

3. Analytical Monitoring

At each site with flowing water, a description of the water color, odor, turbidity, presence of an oil sheen, surface scum, foam, or other floatables, as well as any other relevant observations regarding non-storm water discharges or illegal dumping shall be documented on the field data sheet. In addition, grab samples may be collected for field or laboratory analysis of water quality parameters to provide an indication of the source of the discharge. The following is a list of some suggested indicator parameters:

- Bacteria (Total Coliform, Fecal Coliform, *E. coli, or Enterococcus*)
- Detergents
- Surfactants (MBAS)
- Boron
- Optical Brighteners
- Ammonia-N
- Potassium
- Fluoride

- Chlorine
- Hardness
- Conductivity (TDS)
- Turbidity
- pH
- Temperature

Some of these indicators parameters can be measured in the field. Although these field methods may be less sensitive, accurate, and precise than laboratory analytical methods, they are excellent screening tools in the field considering the data is intended to indicate (and rule out) potential sources of the discharge. Samples can be measured with a suitable combination of field meters, test strips, colorimetric, and spectrophotometric test methods. Field instruments (i.e. water quality meters) should be properly calibrated prior to field use. Test strips are an effective screening tool for source identification studies; however they are usually less sensitive and have lower resolution than meters or higher quality field methods.

Sampling shall be performed in accordance with the monitoring protocols specified in this permit. All samples collected for lab analysis must be analyzed by a laboratory that is licensed by the ADHS Office of Laboratory Licensure and Certification. This requirement does not apply to parameters that must be analyzed in the field at the time of sampling. All samples collected for lab analysis must be analyzed using an approved method as specified in this permit. ADOT shall document the types of analytical methods used for sampling non-stormwater discharges.

G. Source Identification Investigations

The primary objective of dry weather monitoring is to detect and eliminate dry weather discharges (as appropriate) to and from the MS4. As required in Section 3.2.3 of this permit, ADOT shall establish procedures to quickly evaluate and investigate dry weather flows.

Monitoring of specific indicator parameters (i.e. indicator monitoring) is useful to confirm illicit discharges and provide clues about the source of the discharge. Indicator parameters can be used to identify a specific discharge or discriminate between different discharges. No single indicator parameter is adequate to identify a source. A combination of indicator parameters should be selected based on local conditions and discharge types. While indicator parameters may vary across different communities, analysis of a few key parameters is generally adequate to characterize a discharge in most cases. Ideally, indicator parameters should distinguish one type of illicit discharge from another. Refer to Chapter 12 and Appendix F of the IDDE guidance manual for additional information on indicator monitoring parameters and methods (see Section I, References).

The following table provides general guidance to help to characterize possible sources of illicit discharges based on concentrations of indicator parameters:

TABLE 1
Possible Sources Associated With Indicator Parameters

Indicator Parameter	Analytical Results	Possible Sources	Comments
Bacteria (Total Coliform, Fecal Coliform, *E. coli,* or *Enterococcus)*		Indicator of sewage discharges (unless pet or wildlife sources exist in the subwatershed).	Each of these bacteria is found at very high concentrations in sewage compared to other flow types.
E. coli	> 12,000 MPN/100 mL	Possibly sanitary wastewater. Test for ammonia/potassium ratio to distinguish between sewage and washwater sources.	

TABLE 1 Possible Sources Associated With Indicator Parameters			
Indicator Parameter	**Analytical Results**	**Possible Sources**	**Comments**
E. coli	< 12,000 MPN/100 mL	Test for surfactants or boron to identify presence of detergents.	
Detergents	Presence or absence	Detergents (commercial or retail products used to wash clothing) may indicate sewage or washwater discharges (household or commercial laundry discharges). The presence of detergents, combined with their absence in natural waters or tap water, may signify illegal dumping, an illicit connection, or a leaking sewer.	The presence of detergents is usually measured as surfactants or fluorescence. Sewage and washwater discharges contain detergents used to clean clothes or dishes, whereas liquid wastes contain detergents from industrial or commercial cleansers.
Surfactants	> 0.25 mg/L	Indication that the discharge contains detergents. Test for ammonia/ potassium ratio to distinguish between sewage and washwater sources.	
Surfactants	< 0.25 mg/L	Test for fluoride to distinguish between natural or potable water sources.	
Boron	> 0.35 mg/L	Indication that the discharge contains detergents. Test for ammonia/ potassium ratio to distinguish between sewage and washwater sources.	
Boron	< 0.35 mg/L	Test for fluoride to distinguish between natural or potable water sources.	
Optical brighteners (Fluorescence)	Presence or absence	May indicate sewage or laundry discharges (household or commercial laundry discharges). The presence of detergents may signify illegal dumping, a direct illicit connection, a leaking sewer, or leakage from a failed septic system.	Optical brighteners are used in laundry detergents.
Ammonia-N	(see Ammonia/ Potassium ratio)	Indicator of sewage, since its concentration is much higher than in groundwater or tap water. High ammonia concentrations may also indicate liquid wastes from some industrial sites.	
Potassium	(see Ammonia/ Potassium ratio)	Found at relatively high concentrations in sewage, and extremely high concentrations in many industrial process waters. Consequently, potassium can act as a good first screen for industrial wastes, and can also be used in combination with ammonia to distinguish wash waters from sanitary wastes.	
Ammonia/ Potassium ratio	> 1.0	If discharge contains surfactants, and the ratio is > 1.0, then the source is possibly sanitary wastewater.	

TABLE 1 Possible Sources Associated With Indicator Parameters			
Indicator Parameter	**Analytical Results**	**Possible Sources**	**Comments**
Ammonia/ Potassium ratio	< 1.0	If discharge contains surfactants, and the ratio is < 1.0, then the source is possibly washwater.	
Fluoride	> 0.25 mg/L	If the discharge does not contain surfactants, then the source is likely tap water or irrigation source water (i.e. groundwater).	
Fluoride	> 0.60 mg/L	Indicates potable water sources in areas where water supplies are fluoridated.	
Fluoride	< 0.25 mg/L	If the discharge does not contain surfactants, then the source is likely a natural water source (i.e. groundwater).	
Chlorine	Presence or absence	Additional parameter to distinguish between a natural or potable water source. High chlorine levels may indicate a water line break, swimming pool discharge, or industrial discharge from a chlorine bleaching process.	Not a good indicator of sanitary waste water because chlorine will not exist in a 'free state' in water for long.
Hardness		Additional parameter to distinguish between a natural or potable water source. Hardness may help distinguish groundwater from tap water and other flow types.	Hardness may be applicable in communities where hardness levels are elevated in groundwater.
Conductivity/ Total Dissolved Solids (TDS)		Conductivity is often strongly correlated with the total amount of dissolved material in water (TDS). The use of conductivity as an indicator depends on whether concentrations are elevated in "natural" or clean waters.	
Turbidity		High turbidity is often a characteristic of undiluted dry weather industrial discharges, such as those coming from some continual flow sources, or some intermittent spills. Sanitary wastewater is also often cloudy in nature.	
pH	very low (<3) or very high (>12)	Possible indicator of liquid wastes from an industrial source.	
Temperature		Elevated baseflow temperatures (compared to baseflows at other outfalls being screened) could be an indicator of substantial contamination by sanitary wastewater or cooling water.	Useful where the screening activities are conducted during cold months.

ADOT shall initiate a source identification investigation within 15 days of detection. Numerous techniques are available for source identification investigations. Storm drain network investigation involves progressive strategic inspection at manholes in the storm drain network to narrow the location of the discharge. The IDDE guidance manual describes several approaches for this type of investigation, some appropriate for large drainage areas. Other investigation techniques may include smoke testing, video monitoring, and dye testing.

Elimination of illicit connections and illegal discharges is a multi-step process that includes identifying source(s), education and / or enforcement, BMP implementation, and follow-up investigations. It is important to return to the site once the source has been eliminated to confirm the source was identified correctly. Confirmation is especially important for situations where enforcement action is taken.

H. Reporting

ADOT shall report the status of dry weather field screening activities and shall summarize an evaluation of the progress of the dry weather field screening program in the Annual Report..

I. References

- *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments*, Center for Watershed Protection, October 2004.
- *Appendix D, Illicit Connection/Illegal Discharge Detection and Elimination Model Program Guidance,* San Diego Stormwater Co-permittees, November 13, 2001.